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DECLARATION

The undersigned, Dana Scruggs, having an office at 8902B Otis Avenue, Suite 204B, Indianapolis, Indiana 46216, hereby states that she is well acquainted with both the English and German languages and that the attached is a true translation to the best of her knowledge and ability of PCT/DE 2003/003545 (INV.: GROENING, I., ET AL).

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.



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ELECTRIC MOTOR COMPRISING A TEMPERATURE MONITORING DEVICE

The present invention relates to an electric motor comprising a temperature monitoring device.

With every electric motor that is supplied with power using a current converter, the operating temperature is typically monitored to protect the motor. The temperature is usually monitored using temperature sensors, the sensing elements of which are positioned in the direct vicinity of windings of the electric motor. The temperature sensors have specific temperature/resistance characteristics. Temperature sensors of this type usually have a resistance value that increases as the operating temperature increases, which corresponds to a positive temperature coefficient of the temperature sensor. Temperature monitoring and temperature tripping in the electric motor can be realized with the aid of temperature sensors. To monitor temperature, a temperature value detected by the sensor is unequivocally assigned to a certain resistance value. Temperature tripping can be thought of as a thermal switch that is tripped when a certain threshold value is reached and disconnects the electric motor from the current converter that supplies power until the temperature drops back below the threshold value.

Problems often occur in practical application due to the fact that regulating devices in electric motors are not compatible with temperature monitoring devices. In particular, purchasers of electric motors powered by current converters are often forced to select the regulating device that is compatible in terms of the temperature sensor and/or accept the fact that a temperature monitoring sensor system in the electric motor must be adapted in a complex manner to sensor characteristics of temperature sensor inputs of the regulating device using temperature sensors with different temperature characteristics.

1 The task on which the present invention is based, therefore, is to provide an
2 electric motor with a temperature monitoring device that enables, in a simple and
3 convenient manner, the connection of regulating devices having highly diverse
4 temperature sensor input characteristics.

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6 The task is attained by means of the present invention using an electric motor
7 with a temperature monitoring device having the features according to Claim 1.

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9 Preferred further developments of the present invention are stated in the
10 dependent claims.

11
12 According to the present invention, a temperature monitoring device in an electric
13 motor includes at least two temperature sensors with different temperature
14 characteristics. The temperature sensors are connected to terminal clamps on
15 the electric motor via electrical wires. It is advantageously possible to operate the
16 electric motor with regulating devices having highly diverse temperature sensor
17 input characteristics by way of a simple, individually selectable interconnection of
18 temperature sensor inputs of the regulating device with the terminal clamps on
19 the electric motor.

20
21 Advantageously, the electric motor according to the present invention includes
22 temperature sensors with temperature monitoring characteristics and/or
23 temperature sensors with temperature tripping characteristics. The regulating
24 device is interconnected with the electric motor such that the signal from the
25 temperature sensor having the desired temperature sensor characteristics is
26 forwarded to the regulating device.

27
28 The present invention is explained in greater detail below with reference to the
29 attached figures.

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Figure 1 shows a schematic illustration of an embodiment of an electric motor according to the present invention with a temperature monitoring device; and

Figure 2 shows a basic illustration of an electric motor according to the present invention with a temperature monitoring device and with a regulating device for controlling the electric motor.

Figure 1 shows, in a basic diagram, an electric motor 2 with a device 1 for monitoring temperature. Device 1 for monitoring temperature includes a first temperature sensor 10 and a second temperature sensor 11. Temperature sensors 10, 11 can be designed as silicon sensors (KTY sensors) with a positive temperature coefficient. Furthermore, the temperature sensors can be designed as single-fold bimetallic element switches and/or as three-fold bimetallic element switches that enable temperature tripping. Temperature sensors 10, 11 are connected by electrical wires to a first, second and third terminal clamp K1, K2, K3 on electric motor 2.

Any type of thermal resistors having switching or non-switching characteristics can be used as temperature sensor 10, 11. They include, for example, "service-mounted network resistors" (SMN resistor) as specially designed thermal resistors with a positive temperature coefficient and switching characteristics. With the aid of SMN resistors of this type it is possible to monitor three phase windings of the electric motor for thermal tripping. The characteristic curve of the SMN resistor has a defined switching-off point that is transmitted to a regulating device connected to the electric motor, the regulating device having temperature sensor inputs with SMN-resistor characteristics.

An exemplary embodiment of an interconnection of a regulating device 4 with electric motor 2 according to the present invention is shown in Figure 2.

Regulating device 4 includes a first temperature sensor input E1 and a second temperature input E2 that are capable of being connected with terminal clamps

1 K1 through K3 of the electric motor in a specific manner. Regulating device 4
2 controls electric motor 2 via a control line 5 with the temperature sensor values
3 transferred from electric motor 2.

4
5 As shown in Figure 2, the user of regulating device 4 with a specific temperature
6 sensor input characteristic is able to correctly match regulating device 4 by
7 suitably interconnecting the first and second temperature sensor inputs E1, E2
8 and the terminal clamps of electric motor 2. As a result, electric motor 2 now only
9 needs to be equipped with one standard type of temperature monitoring sensor
10 system to be operated with regulating devices having highly diverse temperature
11 sensor input characteristics.

12
13 In the exemplary embodiment in Figure 2, first temperature sensor 10 can be a
14 KTY sensor, for example, and second temperature sensor 11 can be a three-fold
15 bimetallic element switch. Temperature sensors 10, 11 are located in the direct
16 vicinity of a motor winding 3 of electric motor 2. With the aid of the connection of
17 first temperature sensor input E1 of regulating device 4 with first terminal clamp
18 K1, and the connection of second temperature sensor input E2 of regulating
19 device 4 with third terminal clamp K3 as shown, it is possible to use a regulating
20 device 4 having the temperature sensor input characteristics of a KTY sensor
21 and a three-fold bimetallic element switch.

22
23 Furthermore, when temperature sensor inputs E1, E2 of regulating device 4 are
24 connected with first and second terminal clamps K1, K2 of electric motor 2 it is
25 also possible to connect a regulating device 4 having only the sensor
26 characteristics of a KTY sensor.

27
28 Furthermore, by connecting temperature sensor inputs E1, E2 of regulating
29 device 4 with second and third terminal clamps K2, K3 of electric motor 2, it is
30 also possible to connect a regulating device 4 having only the sensor
31 characteristics of a three-fold bimetallic element switch.

1 The manufacturer of the electric motor according to the present invention
2 therefore obtains the advantage that a wide variety of temperature sensor
3 systems to be installed in the motor can be reduced. This advantageously results
4 in reduced inventory of temperature sensors and electric motors and the
5 resultant lower costs. In addition, due to the fact that only one single temperature
6 monitoring sensor system need be provided for each motor, production costs for
7 the electric motor can be advantageously reduced.

8

9 Since the temperature monitoring sensor systems of the electric motor must be
10 installed in the electric motor at a very early stage of the production process, it is
11 normally extremely complicated to carry out subsequent adjustment work to a
12 specific regulating device in the electric motor. This adjustment work can be
13 avoided in a particularly advantageous manner with the present invention.

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15 The user of the electric motor according to the present invention advantageously
16 obtains independence in terms of selecting which regulating device to connect to
17 the electric motor.

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19 The uniform configuration of electric motors in terms of temperature monitoring
20 sensor systems further results in the advantage that the likelihood of error during
21 motor assembly can be reduced.

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Reference Numerals	
1	Temperature monitoring device
2	Electric motor
3	Motor winding
4	Regulating device
5	Control line
10	First temperature sensor
11	Second temperature sensor
E1	First temperature sensor input
E2	Second temperature sensor input
K1	First terminal clamp
K2	Second terminal clamp
K3	Third terminal clamp

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